 **ProVision Technologies, Inc.** 
An **HET** Company

**PV Power into the Grid:
Net Metered Examples on the Big Island**

December 13, 2001

Marco Mangelsdorf

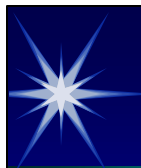
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Company Background

- Unregulated Subsidiary of Hawaiian Electric Industries (HEI)
- Incorporated in June 1998 as a Distributed Generation Company
- Initial Focus on PV Technology
- Provision of Comprehensive PV Services to Hawaii and Asia/Pacific Region (on and off-grid applications)

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Industry Trends:

- Declining Prices – On the Average 4% Per Year Over the Past 15 Years
- Demand Has Grown at Approximately 25% Per Year Over the Past 15 Years (44% from 1999-2000)
- Major Corporate Involvement (BP, Shell, Siemens)
- \$2 Billion in Revenues in 2000; Projected to be \$10-\$20 Billion by 2010

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Product Trends:

- Thin-Film Technologies – 10% Share (lower production costs, increasing efficiencies)
- Building-Integrated (roofing products, curtain walls, glazing)
- AC Modules (micro inverters on each module)
- PV/Thermal Combination Modules
- More Sophisticated Inverter Technologies Available (sine wave, utility interactive, max power point tracking)

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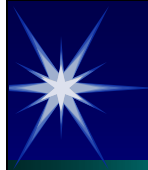
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Future Directions:

- Village Power Systems – Comprehensive Infrastructure (2 billion people without electricity)
- Incentives Supporting Grid-Tied Applications – Increasing Share (government subsidies, tax credits, buy-down programs, net metering)
- Rapid Addition of New Production Facilities (200 MW in 1999 to 250 MW in 2000)
- New Technology Approaches Imply Further Cost Reductions

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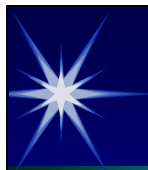




Why install a net metered photovoltaic system?

- State and Federal tax credits available
- Residence and business applications
- A limited-time offer
- Power available during blackouts
- Going “green”

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Challenges to going solar electric

- Large initial purchase price
- Long payback period
- “Won’t it be cheaper if I wait?”
- Beauty in the eye of the beholder
- Photovoltaics as rocket science

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Net Metering in Hawaii

- Signed into law June 2001
- For small-scale (10 kW and less) renewable energy systems connected to the electric grid
- HELCO, HECO, MECO and Kauai Electric required to “pay” net metered system owners retail rate for kilowatt hours fed into the grid
- Spinning the electric meter backwards

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The State's first net metered solar electric system

- Business/residence above Kawaihae
- (48) BP Solar 150-watt single-crystal silicon modules = 7.2 kW peak power
- Typical daily consumption = 90 kWhs
- Solar to supply ~ 30+ kWhs per day
- Back-up power during outages
- “I’ve waited 10 years to do this.” – Lana Plum

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Economics of Commercial Grid-Connected PV

Assumptions:

- System Life: 30 years
- Electric Rate Inflation: 3.6% (avg. of past 10 years)
- Solar Insolation (Kona): 22% capacity factor
- Inverter Replacement: 15 years
- Maintenance Costs: \$100/10 kW/year
- PV degradation: .7% per year
- 35% State Tax Credit

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Economics of Commercial Grid-Connected PV

Assumptions:

- 10% Federal Tax Credit
- 4% Capital Goods Excise Tax Credit
- MACRS Accelerated Depreciation
- 2 Perspectives: Untaxed and Taxed
Incentives/Energy Savings
- Systems Paid for Without Loan

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Economics of Residential Grid-Connected PV

Assumptions:

- System Life: 30 years
- Electric Rate Inflation: 4.4% (avg. of past 10 years)
- Solar Insolation (Kona): 22% capacity factor
- Inverter Replacement: 15 years
- Maintenance Costs: \$100/10 kW/year
- PV degradation - .7% per year
- State Tax Credit Limited to \$1,750
- Financing @ 7% for 360 months

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Economics of Residential Grid-Connected PV

Case Study: 4.3 kW_{AC} System without Batteries

- System Cost: \$10/watt = \$43,000 + Tax
- Utility Electric Cost: 21.5¢/kWh
- Annual KWh Production: 8,287 kWh
- Payback Period: 18 years
- 30-year Savings: \$46,843
- Adding Solar Thermal and C.F. Lamps: 15-year Payback Period

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HELCO's Second Net Metered System

- Mehring residence, Waikoloa Village
- (20) BP Solar 150-watt modules = 3 kW peak power
- Sunny Boy 2500U inverter – first in state
- Total daily kWh consumption (approx. 14 kWh) of home to be met by PV system
- Jeff and Tamiyo wanted to supply 100% of their family's power needs from solar – a “first adopter” not driven by payback period

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Battery-based vs. Battery-less

- Battery-based system = power available during utility interruptions
- Battery-based system = higher cost and lower efficiency
- Battery-less system = simpler, quicker installation
- Battery-less system = lower cost and higher efficiency

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HELCO Kailua-Kona Engineering Office

- Grid-connected, highly visible system
- Educating the public
- Original design: (36) BP Solar 150-watt modules (5.4 kW peak power) with Trace SW5548 inverter and with 5 kWh AGM battery storage
- Nasty news from Northbrook
- AEI to the rescue

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